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ABSTRACT

Piaget, in describing the sequence of classificatory development, describes class inclusion as composed of two processes; hierarchical classification and post-whole comparisons. In the experiment reported here, elementary school children, trained in the concept of sets in first grade mathematics were given a task where they were required to assess a relationship between majority subclass and its superordinate class. Second and third graders were significantly more capable than were first graders, but no sex differences were indicated. Performance on the relational assessment task, (Hierarchical classification of subsets and superordinate sets) was better than performance on the traditional task where subjects compared subordinate and superordinate sets. (KS)

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Two Operations in Class Inclusion: Part-whole Comparisons and Hierarchical Classification

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Inhelder & Piaget, in The Early Growth of Logic, explored the emergence of classificatory operations. The operations of part-to-whole comparisons and hierarchical classification have been described as indicators of the onset of concrete operational intelligence and as evidence of the understanding of class inclusion. Part-to-whole comparisons imply that the subordinate class is some, but not all of the superordinate class: part (A) < whole (B). Hierarchical classification involves the understanding that a superordinate class is composed of the sum of subsets.

In his theory, Piaget refers to both part-whole comparisons and hierarchical classification as components of class inclusion; but in his research, he focuses primarily on the part-whole comparisons. Other researchers who have investigated class inclusion have followed Piaget and have also used tasks which require part-whole comparisons, i.e., the typical part-whole problem. This problem involves presenting an array of objects to a child and questioning him/her on the relation between the major subordinate and the superordinate class. For example, when presented with an array of seven dogs and three horses, the child would be asked "are there more dogs or more animals?" The typical pre-operational child, who fails at class inclusion, would generally respond with the label of the subordinate group, "dogs." The concrete operational child can generally make an appropriate part-whole comparison and would answer "animals."

In the research literature there has been little regard for the child's ability to subdivide a superordinate class into its subsets and yet recognize that the superordinate group still exists (hierarchical classification). One objective of the present research was to investigate both the part-whole comparisons and the hierarchical classification abilities in early grade school children.

Kofsky (1966) examined the relationship between 11 classification abilities including part-whole comparisons and hierarchical classification. With a scalogram analysis of the skills, Kofsky found that hierarchical classification and part-whole comparisons did not emerge in an invariant order. That is, all children who passed the harder did not necessarily also pass the easier. A second objective of the present research was to examine the relationship between the two components in class inclusion. The requisite relation of the processes was examined by scaling analysis to determine if one process is a precursor to the other.

A third major concern of the present research involved the methodology of the part-whole comparisons. Although Piaget has claimed that a decisive task to determine evidence of class inclusion is to ask for an appropriate part-whole comparison, an examination of the methodologies used reveals that the child is never required to directly assess that relationship. That is, the child never uses a relational term to indicate the comparison between A and B. The child's response is always in the form of a label of one class or another. For example, asking for a comparison of dogs and animals ("are there more dogs or more animals?") typically yields one of two responses, "dogs" or "animals." The child, however, does not supply the relationship that there are "more animals than dogs" or that "some of the animals are dogs." It is then in an oblique manner that the child's ability to compare part and whole is assessed.

The present research used a methodology designed to test for part-whole comparisons by requiring the child to directly assess a relationship between the majority subclass and its superordinate class. Beginning in the first grade, elementary school mathematics curricula introduce the concept of

"relations" and the appropriate symbols, < , > . Children learn to assess relations between two quantities or sets. The present methodology required the child to assess a relation using the mathematical inequality symbol. A traditional part-whole task was also given as a comparison.

Method

Subjects

Subjects were selected from first, second, and third grades. Mean ages were 6.7, 7.6, and 8.9 years. There were nine of each sex from each grade, resulting in 54 subjects.

Materials

Stimuli were arrays either in picture or object form. Each array constituted a superordinate class which could be subdivided into a major and a minor subordinate class (e.g., 8 fruits = 5 apples + 3 oranges).

Procedure

Pretest. Each subject had passed pretests on reading ability, use of mathematical relational symbols, and understanding of the relational term "more."

Class Inclusion Conditions. Three class inclusion conditions were given to each child (hierarchical classification, relational assessment, and the traditional A < B condition). Each condition consisted of four trials with a different array presented for each trial. Order of the three conditions was counterbalanced across grades and sex.

Condition I: Hierarchical Classification (HC). A board with a schematic tree diagram was placed in front of the child with an array (see figure 1). It was explained that for each array several groups could be made. The box at the top was for the name of the biggest group, and the boxes at the bottom were for the names of two smaller groups. The subject was asked to

tell the experimenter the names of the groups which could be made. These names were written on labels and given to the subject to place in the appropriate box.

Condition II: Relational Assessment (RA). An array was laid out for viewing. Labels for the superordinate class and the majority subordinate class were placed on the table with a question mark between them. This is the same format used in the elementary arithmetic curriculum and the children easily understood that their task was to replace the question mark with the appropriate mathematical symbol, > or < , to express the appropriate relationship.

Condition III: Traditional Test. An array was presented and the question was asked "are there more A or more B?"

Results and Discussion

Each subject's score on each of the three class inclusion tasks was the total number of correct responses on the four trials of that task. Thus, scores ranged from 0 - 4 for each subject for each task. Percentages of correct responding for each task are presented in Table 1. These data were analyzed by a 3(grade) X 2(sex) X 3(task) fixed model analysis of variance with repeated measurements on the task factor.

Results indicate a significant grade effect. On all measures the first grade subjects had significantly fewer correct responses than the second and third grade subjects, but performance of the second graders did not differ significantly from that of the third graders. There were no sex differences. Overall the children were better able to hierarchically classify subsets and a superordinate set (HC) than to compare a subordinate and a superordinate set (RA or the traditional test).

One hypothesis of the research was that performance on the relational assessment task would be better than performance on the traditional task. Results supported this hypothesis. The RA task, a modification of the traditional task, was designed to increase the child's chances of understanding the problem by removing linguistic variables in interrogation and response and to provide a direct assessment of a relation. The present use of a direct relational assessment task proved effective in examining part-whole comparisons. This same mathematical framework might very well be integrated into testing for other operations traditionally examined in a linguistic framework.

The second component of class inclusion, hierarchical classification, was also examined. Performance on hierarchical classification was well over 80% correct in all three grades. Children had little difficulty with the method provided. There remains the possibility that this performance might have broken down had more complex and multi-leveled hierarchies been presented. Kofsky (1966) reported that HC was the most difficult of 11 classification tasks for her subjects. Kofsky used a less direct measure. Her subjects were presented with red and blue triangles. Instructions were "all of these are called MEF's, but only some are TOV's. What are MEF's? Which are TOV's?" Six-, seven-, and eight-year olds responded correctly 0%, 14%, and 20% of the time respectively. The use of nonsense syllables and the terms "some" and "all" appears to have resulted in a very indirect assessment of the child's ability to hierarchically classify. The present research methodology provided a more direct and concrete assessment of hierarchical classification and resulted in high level of accuracy.

The three tasks were ordered from easiest to hardest as follows: HC - RA - TT. This suggests that HC was the easiest of the three tasks. To examine the possibility that the classification tasks form a scale,

inter-item homogeneities (Loevinger, 1947) were computed for each pair of tasks. This statistic gives some indication of the extent to which passage of one task implies passage on all easier tasks. Inter-item homogeneities were lower than chance expectancy suggesting that the tasks do not scale well.

A question arises regarding the final step in Piaget's sequence of classificatory development. Class inclusion is composed of two processes: hierarchical classification and part-whole comparisons. Do these two processes appear in invariant order in a child's acquisition? The results of the present study and Kofsky's research indicate that there are no clear prerequisites of components within the process of class inclusion. The tasks do not emerge in an invariant order. Further research on these classification abilities is necessary to determine factors which might influence the relationship between these two components.

The implications of the present research suggest that 1) it is important to consider both aspects of class inclusion and their relationship and 2) for a more accurate measure of performance, direct and concrete methodologies need to be used.

References

Inhelder, B. & Piaget, J. The early growth of logic in the child. London: Routledge & Kegan Paul, 1964.

Kofsky, E. A scalogram study of classificatory development. Child Development, 1966, 37 (1), 191-204.

Loevinger, J. A systematic approach to the construction and evaluation of tests of ability. Psychological Monographs, 61 (4), Whole No. 285, 1947.

Table 1

Percentages of Correct Responses

		task		
		traditional task	relational assessment	hierarchical classification
grade:	1st	49	63	85
	2nd	78	86	93
	3rd	78	89	92
	total	68	79	90

Figure 1. Schematic used for hierarchical classification